REMARKS

Claims 1, 2 and 7-19 remain pending for further prosecution in the present application. Applicant submits arguments for overcoming the rejections over the prior art of record and respectfully submits that the present application is in condition for allowance.

I. Claim Objection

> *In the FINAL Office Action dated March 3, 2009, claim 15 is objected to because of a formality relating to the absence of the word "is".*

Claim 15 has been amended to address the above referenced formality. No new matter was added. Applicant respectfully requests removal of the objection.

II. Claim Rejections - 35 USC §112

> *A. In the FINAL Office Action dated March 3, 2009, claims 7-10 and 12-19 are rejected under 35 USC §112, first paragraph, as failing to comply with the written description requirement.*

In the FINAL Office Action, it is stated that the limitation recited in dependent claims 7, 12 and 16 requiring the hafnium material to have a residual resistance ratio of at least 120 is not supported by the specification of the present application, as filed. Applicant respectfully disagrees and respectfully requests reconsideration and removal of this rejection.

The unmet need at the time of the invention for hafnium materials having a high residual resistance ratio is discussed on page 3, lines 1-4, of the present application, as filed, as follows:

> "In particular, materials having a high ***residual resistance ratio*** are being demanded, and, since a high purity hafnium material could not be obtained conventionally, it was not possible to sufficiently meet the demands as electronic component materials since the ***residual resistance ratio*** was low."

With respect to the hafnium material according to the present invention, the present application on page 4, lines 19-21, states as follows:

> "Moreover, it is possible to obtain a thin film having a high ***residual resistance ratio*** from the high purity hafnium material, which will be able to sufficiently meet the demands as an electronic component material."

Also, see page 5, line 33, to page 6, line 2, of the present application, as filed, which states:

> "Moreover, a material having a ***high residual resistance ratio*** can be obtained from the foregoing high purity hafnium material as described in the following Examples, and it is possible to sufficiently meet the demands as an electronic component material."

The residual resistance ratios of the materials of Examples 1 to 3 made according to the present invention are discussed on page 9, lines 4-9, of the present application, as follows:

> "With respect to the foregoing Examples 1 to 3, results of measuring the ***residual resistance ratio*** are shown in Table 4. As a result, as shown in Table 4, the ***residual resistance ratio*** at the ingot stage in Examples 1, 2 and 3 is respectively 38, 22 and 45, but respectively increased after deoxidation at 200, 120, and 190. Like this, it is evident that hafnium having a ***high residual resistance ratio*** can be obtained from hafnium having ultra high purity."

From the above passage, it is clear that the residual resistance ratio is "low" at the "ingot stage" of making the ultra high purity hafnium material and "high" after deoxidation treatment according to the present invention. Residual resistance ratios of 38, 22 and 45 are considered "low"; whereas, residual resistance ratios of "200, 120 and 190" are considered "high".

Further, a Comparative Example is disclosed on page 9, lines 15-20, of the present application, as filed. The raw material of the Comparative Example is the same as that used for Example 2 according to the present invention. Unlike Example 2, the raw material of the Comparative Example was merely subject to plasma arc melting to form an ingot and was not

subjected to deoxidation treatment. Page 9, lines 19-20, of the present application, as filed, clearly states that "the ***residual resistance ratio*** was low at 5."

Finally, Table 4 on page 9 of the present application, as filed, clearly lists the "Residual Resistance Ratio" in the right-hand column for each of Examples 1 to 3 at the "ingot" stage and "after deoxidation" and lists the residual resistance ratio for the ingot of the Comparative Example.

Claims 7, 12 and 16 of the present application each require the high purity hafnium material, the sputtering target, and the thin film to have a residual resistance ratio that is "at least 120". As discussed above, page 9 of the present application, as filed, discloses Examples 1 to 3 that have a residual resistance ratio after deoxidation of **200, 120, and 190**. A mathematical commonality of these disclosed numbers is that they are all "at least 120". Thus, support for this limitation is clearly found in the specification of the present application, as filed. Further, the present application clearly discloses an objective of providing a high purity hafnium material that has a "high" residual resistance ratio that will enable such material to sufficiently meet the demands as an electronic component material.

Accordingly, it is respectfully submitted that the above referenced limitation in claims 7, 12 and 16 comply with the written description requirement of §112, first paragraph, and are described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor, at the time the application was filed, had possession of the claimed invention, in this case a "high" residual resistance ratio which is defined by the Examples as being at least 120. Applicant respectfully requests reconsideration and removal of the §112, first paragraph, rejection of claims 7, 12 and 16 for these reasons.

In the FINAL Office Action, it is stated that the limitation recited in dependent claims 8, 13 and 17 requiring the hafnium material to have a residual resistance ratio of 120 to 200 is not supported by the specification of the present application, as filed. Applicant respectfully disagrees and respectfully requests reconsideration and removal of this rejection.

The need for hafnium materials having "high" residual resistance ratios is clearly discussed in the present application, as filed, for the reasons recited above. The present application specifically states that the Comparative Example disclosed on page 9 of the present application has a "low" residual resistance ratio of 5. As discussed above, page 9 of the present application, as filed, discloses Examples 1 to 3 according to the present invention have a residual resistance ratio after deoxidation of 200, 120, and 190. A mathematical commonality of these disclosed numbers is that they fall within the range of "120 to 200". Thus, support for this limitation is clearly found in the specification of the present application, as filed.

Accordingly, it is respectfully submitted that the above referenced limitation in claims 8, 13 and 17 comply with the written description requirement of §112, first paragraph, and are described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor, at the time the application was filed, had possession of the claimed invention. Applicant respectfully requests reconsideration and removal of the §112, first paragraph, rejection of claims 8, 13 and 17 for these reasons.

B. *In the FINAL Office Action dated March 3, 2009, claims 7-10 and 12-19 are rejected under 35 USC §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.*

In the FINAL Office Action, it is stated that in regards to claims 7, 12 and 16, the upper limit of the residual resistance ratio is unclear and undefined by the recitation "wherein said high purity hafnium has a residual resistance ratio of at least 120".

With respect to claims 8-10, 13-15 and 17-19, these claims have been amended to no longer depend from any of claims 7, 12 and 16. Thus, for at least this procedural reason, Applicant respectfully submits that the §112, second paragraph, rejection of claims 8-10, 13-15 and 17-19 should be removed.

With respect to claims 7, 12 and 16, page 9 of the present application, as filed, discloses Examples 1 to 3 having residual resistance ratios after deoxidation of 200, 120, and 190. A mathematical commonality of these disclosed numbers is that they are all "at least 120". There is nothing indefinite about a limitation requiring "at least 120". This limitation particularly points out and distinctly requires a hafnium material having a residual resistance ratio of at least 120. Thus, a hafnium material having a residual resistance ratio of 120 or more is covered by the claim and a hafnium material having a residual resistance ratio of less than 120 is not covered by the claim.

Applicant respectfully submits that the absence of an upper limit to the range does not render such a mathematical limitation indefinite. If a hafnium material has a residual resistance ratio of 120 or more then the limitation is met. If a hafnium material has a residual resistance ratio of less than 120 then the limitation is not met. There is simply no uncertainly with respect to interpreting this limitation. This mathematical limitation cannot be made any more definite than it already is.

For these reasons, Applicant respectfully requests reconsideration and removal of the §112, second paragraph, rejection of claims 7, 12 and 16.

III. Claim Rejections - 35 USC §103(a)

A. In the FINAL Office Action dated March 3, 2009, claims 1-2 and 7-19 are rejected under 35 USC §103(a) as being obvious over U.S. Patent Application Publication No. 2003/0062261 A1 of Shindo.

Applicant respectfully requests reconsideration and removal of the above referenced rejection because: (i) the disclosure provided by the '261 Shindo application publication has been misinterpreted; and (ii) because the present invention recites a critical range that provides unexpected results.

On page 4 of the FINAL Office Action, it is stated that:

> "Oxygen and carbon would be present at levels less than 100ppm and forming a sputtering target or thin film (**claim 4**)".

On page 9 of the FINAL Office Action, it is stated that:

> "In response, Examiner notes that oxygen and carbon would be present at levels less than 100ppm, which includes 0 ppm oxygen (**claim 4**)."

Applicant respectfully submits that these statements are inaccurate and respectfully requests reconsideration based on these inaccuracies.

Turning first to the specific language of **claim 4** of the '261 Shindo application publication on which the above statements are based, the recited purity level of the hafnium material is consistently determined **excluding zirconium and gas components (such as oxygen, carbon and nitrogen) as impurities**. For example, see Paragraph No. 0090 of the '261 Shindo published application. This is conventional practice. Claim 4 of the '261 Shindo published application is no exception. Claim 4 of the '261 Shindo published application requires:

"… the content of impurities excluding Zr and gas components such as oxygen and carbon is less than 100ppm."

A proper interpretation of claim 4 of the '261 Shindo published application is that the "content of impurities" in the hafnium material is less than 100ppm; however, **this specifically excludes zirconium and gas components from consideration as impurities**. Of course, by gas components, claims 4 of the '261 Shindo published application refers specifically to oxygen and carbon. **Thus, this claim does not disclose that oxygen would be present at levels of less than 100ppm; rather, it simply discloses that oxygen is excluded from the purity determination**.

The reason why zirconium and gas components are conventionally excluded from the impurity calculation is that zirconium and gas components in hafnium have not been considered important and can be tolerated. For example, the '261 Shindo patent application teaches to one of ordinary skill in the art that a large quantity of zirconium is contained in hafnium, that the separation and refinement between the two is difficult, and that the presence of zirconium "may be ***disregarded*** since the purpose of use of the respective materials ***will not hinder*** overall purpose hereof." (See Paragraph No. 0061 of the '261 Shindo published application.) Also, Paragraph No. 0065 of the '261 Shindo published application teaches to one of ordinary skill in the art that it is "***extremely difficult to reduce Zr*** in high purity hafnium" and "the fact that Zr is mixed in high-purity hafnium ***will not aggravate*** the properties of semiconductors, and ***will not be a problem***."

The same conventional sentiment is true for gas components, such as oxygen. Hafnium is an element that has a strong bond with oxygen, and the reduction of oxygen from hafnium is extremely difficult. Oxygen exists in hafnium in large quantities, not in trace amounts. By way of example, Table 4 shown on Paragraph No. 0131 of the '261 Shindo published application

excludes gas components, such as carbon, oxygen and nitrogen, because according to conventional thinking, gas components are believed harmless, even if in large quantities.

Electron beam melting is described in the '261 Shindo published application. Electron beam melting cannot reduce oxygen to levels required by the present application. The '261 Shindo published application merely requires oxygen content to be at a level of about 500wtppm. Oxygen content is not considered overly important by the '261 Shindo published application. One example of the '261 Shindo published application shows oxygen content of 120wtppm after electron beam furnace melting. See Paragraph Nos. 0089 and 0092 of the '261 Shindo published application. Another example does not even bother to list oxygen content. See Paragraph No. 0131 of the '261 Shindo published application.

In contrast to the disclosure of '261 Shindo published application, the present application discloses the use of electron beam melting followed by deoxidation treatment with molten salt to produce a hafnium material. The oxygen contents identified in Tables 1, 2 and 3 of the present application for Examples 1, 2 and 3 at the "ingot stage" before deoxidation are 250wtppm, 400wtppm, and 100wtppm, respectively. Thereafter, each of the ingots was subjected to deoxidation with molten salt. This produced the desired oxygen contents for Examples 1, 2 and 3 of less than 10wtppm, 20wtppm, and less than 10wtppm, respectively. A reduction in oxygen content is one of the main objects and an important feature of the present invention. All claims of the present application require oxygen content of 40wtppm or less. Dependent claims 9, 14 and 19 require oxygen content of 10wtppm or less.

Accordingly, Applicant respectfully submits that one of ordinary skill in the art following the teachings of the '261 Shindo published application is not taught how to reduce oxygen

content below 120wtppm and is not provided any common sense reason or motivation for limiting oxygen content to the reduced levels required by the claims of the present application.

Therefore, Applicant respectfully submits that claims 1, 2 and 7-19 of the present application are not obvious in view of the '261 Shindo published application. Applicant respectfully requests reconsideration of the disclosure of the cited reference and reconsideration and removal of the rejection.

In addition, the requirement of oxygen content being 40ppm or less as required by the claims of the present application is **critical and provides an unexpected result** relative to the teachings provided to one of ordinary skill in the art by the '261 Shindo published application.

As discussed above with respect to the §112 rejections, the present application states that hafnium materials having low residual resistance ratios cannot be used as electronic component materials because they do not meet the demand of having a high residual resistance ratio. Page 9 of the present application, as filed, discloses an ingot material of a Comparative Example having 7,000wtppm of oxygen content. The residual resistance ratio of the Comparative Example "was low at 5" and did not meet the requirements needed of an acceptable electronic component material. Also, even the materials of Examples 1 to 3 of the present application at the "ingot stage" before deoxidation treatment with molten salt had low residual resistance ratios of 38, 22 and 45 despite having oxygen contents as low as 250wtppm, 400wtppm and 100wtppm. Note that the ingot of Example 3 of the present application has an oxygen content of 100wtppm (see Table 3 on page 9 of the present application, as filed) which is less than that disclosed in the '261 Shindo application publication. The residual resistance ratio of this ingot was only 45. Example 3 was only able to exceed a residual resistance ratio of 120 after the ingot was subjected to deoxidation treatment with molten salt.

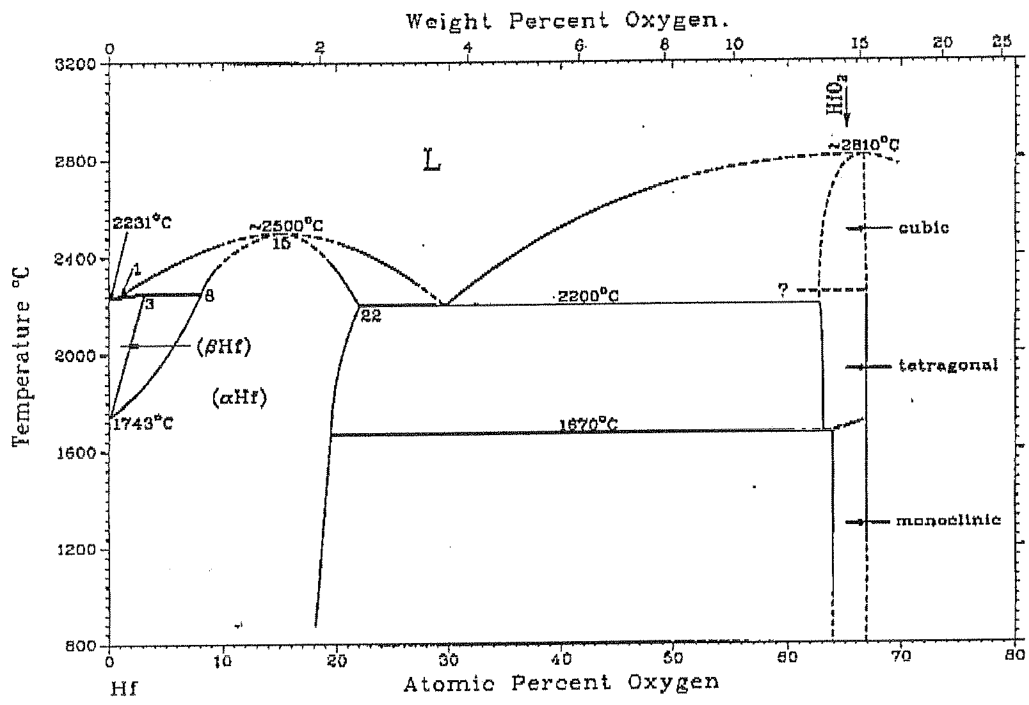
Accordingly, the range of oxygen content required by the claims of the present application is critical to provide a hafnium material with a high residual resistance ratio. In addition, this result is unexpected to one of skill in the art following the teachings of the '261 Shindo application publication which only requires oxygen content to be reduced to about a 500wtppm level. There is no disclosure of any benefit achieved beyond this level.

It should also be noted that the '261 Shindo published application fails to disclose a refining step of subjecting an ingot to deoxidation with molten salt which makes possible the reduction of oxygen to 40wtppm or less required by the claims of the present application. (For example, see page 5, lines 21-26, of the present application, as filed.) Despite this fact, the rejection asserts that the hafnium material disclosed by the '261 Shindo application publication contains an oxygen content as low as "0wtppm". Nonetheless, this assertion completely and unfairly ignores the physical properties of hafnium.

An Hf-O phase diagram is provided on the following page and illustrates that the solubility of oxygen to hafnium is high; more specifically, the solubility of oxygen to hafnium is 1wt% or higher. Accordingly, it is not easy to stably eliminate oxygen content from hafnium due to the above referenced physical property of hafnium.

Accordingly, Applicant respectfully submits that it is fundamentally and technically inappropriate to argue that a hafnium material containing oxygen in an amount of 40wtppm or less can be stably produced by the method disclosed by the '261 Shindo application publication. The reduction of oxygen has its limits based on the method of its purification. The '261 Shindo application publication only discloses electron beam melting, and it is not possible to achieve the oxygen content required by the claims of the present application solely with electron beam melting.

Hf-O phase diagram.



Accordingly, the refining of high purity hafnium in the '261 Shindo application publication is different than that of the present invention, and the awareness of the importance of the presence of zirconium and oxygen in the high purity hafnium is distinctly different. It should be understood that high purification of hafnium with respect to zirconium and oxygen content is complicated and extremely difficult to achieve and should not be considered trivial or obvious. In addition, Applicant respectfully submits that the significance of the advancement provided by the present application should not be overlooked as the claimed ranges are critical and achieve results that are unexpected by one of ordinary skill in the art following the teachings of the '261 Shindo application publication.

For these reasons, Applicant respectfully submits that the claims of the present application are patentable over the '261 Shindo application publication.

B. *In the FINAL Office Action of March 3, 2009, claims 1, 2, 7-10 and 16-19 are rejected under 35 USC §103(a) as being obvious over ASM Handbook Volume 2, pp. 1093-1097.*

Applicant respectfully requests careful reconsideration of the actual, true and fair disclosure provided by page 1094 of the ASM handbook reference. Applicants respectfully submit that the reference has been misinterpreted and that disclosures that are not actually stated by the reference are being read into the reference.

The rejection relies on the disclosure of the section having the sub-heading "Chemical Vapor Deposition" that begins in column 2 and ends within column 3 of page 1094 of the cited reference. The second paragraph of this section reads as follows:

> "One of the more popular of the chemical vapor deposition processes is the iodide process, **which has been used extensively to purify titanium zirconium and chromium**".

The third paragraph of this section begins with the words "In this process". This opening phrase specifically refers to the "iodide process" disclosed in paragraph two of this section used with respect to titanium, zirconium and chromium. For example, the third paragraph refers to purities of 99.96% for titanium, 99.98% for zirconium, and 99.995% for chromium. The third paragraph concludes with the statements that:

> "**Chromium** has been purified to its highest state to date by this method. Only iron is carried over with **these metals** to a significant extent. Thus, if a low-iron starting metal is used, the condensed vapor will approach a purity level of 99.999%."

The "approach a purity level of 99.999%" statement of the reference refers specifically to chromium, not hafnium. In addition, the only metals that could possibly be included in "these metals" are titanium, zirconium and chromium which are the subject of this particular paragraph. This statement is not made with respect to hafnium, and it is simply unfair to misread this statement otherwise.

In the last paragraph of the section, it is stated that "other metals" have been purified and that the "other metals" include hafnium. However, the "other metals" are clearly not included in the "these metals" recitation in the preceding (i.e. third) paragraph of the section. The reference to "these metals" is made before a reference to hafnium or the "other metals" is ever made.

Accordingly, Applicants respectfully submit that reading hafnium into the third paragraph of the "Chemical Vapor Deposition" section of the ASM Handbook reference is incorrect and inappropriate. The statements in the third paragraph apply to chromium and perhaps to titanium and zirconium. The statements clearly cannot be applied to hafnium or "other metals".

Accordingly, Applicant respectfully submits the ASM Handbook merely discloses that hafnium is among a group of "other metals" that can be purified to some undisclosed level by a chemical vapor deposition method. (See the final paragraph of the section titled "Chemical Vapor Deposition" on page 1094.) The ASM Handbook clearly fails to specifically disclose the zirconium content and oxygen content of a purified hafnium metal. In fact, Tables 1 to 3 of the reference do not even include hafnium within the metal samples produced and tested. Table 2 (page 1096) lists Hf only as an "impurity element" within other metal samples. It should also be noted that Table 2 identifies a purified zirconium sample having 200ppm by weight of oxygen content.

As discussed above, it is conventional practice to exclude zirconium and gas components, such as oxygen, from the purity calculation of hafnium. Furthermore, it is conventional knowledge that it is technologically difficult to eliminate zirconium content and oxygen content from hafnium. Accordingly, the ASM Handbook fails to make obvious to one of ordinary skill

in the art a hafnium material having a zirconium content of 0.1wt% or less and oxygen content of 40wtppm or less as required by the claims of the present application.

All the reasons provided above with respect to the patentability of the claims of the present application over the '261 Shindo published application equally apply to the rejection based on the ASM Handbook. One of ordinary skill in the art is provided with no knowledge, teachings or grounds for conceiving the invention required by the claims of the present application. Conventional teachings are that zirconium and oxygen content in hafnium can be "disregarded", "will not aggravate the properties of semiconductors", and "will not be a problem". There is no common sense reason for reducing these contents, and it is readily admitted in the prior art that it is extremely difficult to reduce such content.

Accordingly, Applicant respectfully submits that the ASM Handbook fails to describe in any way the zirconium content and oxygen content in purified hafnium. Statements in the ASM Handbook relative to chromium or "these metals" (chromium, titanium and zirconium) cannot be attributed to hafnium.

Accordingly, Applicant respectfully submits that claims 1, 2, 7-10 and 16-19 of the present application are not obvious in view of the ASM Handbook. Applicant respectfully requests reconsideration and removal of the rejection.

IV. Conclusion

In view of the above amendments and remarks, Applicant respectfully submits that the claim rejections have been overcome and that the present application is in condition for allowance. Thus, a favorable action on the merits is therefore requested.

Please charge any deficiency or credit any overpayment for entering this Amendment to our deposit account no. 08-3040.

Respectfully submitted,
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